AEROJET ROCKETDYNE
Ideas Powering Freedom

7499 Pine Stake Road
Culpeper, VA 22701

Tel: 540-854-2000
Fax: 540-854-2002

November 20, 2017

Via FedEx

Mr. Luis A. Pizarro, Associate Director
Office of Remediation 3 LC20
Land and Chemicals Division
U.S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103

Re: Submittal of the Twenty-seventh (27th) Annual Air Monitoring Report Pursuant to the RCRA Research, Development, and Demonstration (RD&D) Permit for the Aerojet Rocketdyne, Inc., Orange County, Virginia Facility, EPA ID No. VAD981112618

Dear Mr. Pizarro:

Pursuant to the RCRA Research, Development, and Demonstration (RD&D) Permit for the Aerojet Rocketdyne, Inc., Orange County facility, I am submitting the Twenty-seventh (27th) Annual Air Monitoring Report. This report includes thermal treatment events from September 1, 2016 to August 31, 2017. There were eleven (11) treatment events/burns during the reporting period.

The report summarizes the results of: (1) an air quality review including burn monitoring parameters and statistical evaluation of air monitoring results of selected metals [i.e., aluminum (Al), chromium, (Cr), and lead (Pb)], ammonia (NH3-N), hydrochloric acid (HCl), carbon monoxide (CO), and total suspended particulates (TSP); and (2) a worst case scenario validity evaluation of inputs to the air dispersion modeling and risk assessment.

If you have any questions concerning the annual air monitoring report, please call me at 540-854-2037 or tim.holden@Rocket.com.

Sincerely,

AEROJET ROCKETDYNE, INC.

Timothy E. Holden

Timothy E. Holden
Sr. Manager – Safety, Health & Environment
Principal Investigator

cc: L. Romanchik, VA-DEQ/Waste Division
R. Doucette, VA-DEQ/NRO
B. Schwennesen, Aerojet Rocketdyne
B. Wheatley, Aerojet Rocketdyne
D. Rymph, Aerojet Rocketdyne
C. Meredith, Versar

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TWENTY-SEVENTH (27TH) ANNUAL AIR MONITORING REPORT PURSUANT TO THE RCRA RESEARCH, DEVELOPMENT, AND DEMONSTRATION (RD&D) PERMIT FOR THE AEROJET ROCKETDYNE, INC. ORANGE COUNTY, VIRGINIA FACILITY

EPA ID NO. VAD981112618

NOVEMBER 20, 2017

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I. INTRODUCTION

Pursuant to Aerojet Rocketdyne, Inc.'s (Aerojet Rocketdyne's) RCRA Research, Development, and Demonstration (RD&D) permit for the thermal treatment facility at their Orange County, Virginia facility, this twenty-seventh (27th) Annual Air Monitoring Report has been prepared for the period of September 1, 2016 to August 31, 2017. This annual report includes information on eleven (11) thermal treatment events conducted during this period:

1. Burn 326A October 4, 2016
2. Burn 326B October 11, 2016
3. Burn 328A December 14, 2016
4. Burn 329A January 25, 2017
5. Burn 330A February 15, 2017
6. Burn 330B February 28, 2017
7. Burn 331A March 16, 2017
8. Burn 331B March 30, 2017
9. Burn 333A May 10, 2017
10. Burn 334A June 21, 2017
11. Burn 336A August 23, 2017

This report includes the monitored Inpuff 2.2 parameters, an evaluation of whether the worst-case scenarios as inputs to the risk assessment are valid, and a review of the air quality data for the annual reporting period.

II. MONITORED INPUFF 2.2 PARAMETERS SUMMARY

Prior to initiating thermal treatment operations, computer modeling using the Inpuff 2.2 dispersion model was conducted based on worst-case assumptions to evaluate peak carbon monoxide concentrations during thermal treatment. During the operational phase, the Inpuff parameters are measured to allow fine tuning of the model should the actual field results not agree with the predicted concentration. This fine tuning of the model could be necessary, because no model has been fully validated for the unique conditions during the open burning of waste propellants and explosives.

As required by the EPA-approved Operational Monitoring Plan (OMP), weight of burn, plume temperature, plume spread (vertical and lateral), plume height, wind speed, wind direction, and burn duration are determined during each thermal treatment event. The

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PG stability class was determined by vertical and lateral dispersion coefficients as a function of downwind distance and weather categories (Gifford, F.A., Jr. "Use of Routine Meteorological Observations for Estimating Atmospheric Dispersion"). The monitored Inpuff 2.2 parameters for each burn and for each thermal treatment unit are shown in Table A-1 of Appendix A.

III. WORST-CASE SCENARIO VALIDITY EVALUATION

A sensitivity analysis was conducted at the request of EPA to determine the Inpuff 2.2 dispersion model input parameters that would represent the worst-case scenarios (ARC, Sept. 7, 1990). The model uses conservative assumptions to determine maximum carbon monoxide concentrations. During thermal treatment operation, air monitoring was conducted to confirm that the worst-case conditions were not exceeded at the facility. To evaluate the validity of the worst-case scenarios, the data collected from the downwind monitoring stations were compared to the predictive output of the Inpuff model. If the downwind carbon monoxide concentrations do not exceed the predicted concentration, the worst-case scenario would be determined to be valid. The comparison of model input parameters representing the worst-case scenario with actual monitoring parameters is shown in Table A-2 of Appendix A.

The maximum carbon monoxide concentration from the actual monitored data was 0.96 parts per million (ppm)(range of 0.24 – 0.96 ppm), which is less than the maximum predicted concentration of 4.75 ppm. The monitored concentrations, as well as the modeled concentrations, did not exceed the Permissible Exposure Limit (PEL) of 50 ppm. Therefore, the worst-case was determined to not pose a risk to human health (Versar, September 15, 1990). Also, because the predicted carbon monoxide concentration was not exceeded, the worst-case scenario is deemed valid and no fine tuning of the model is needed.

IV. AIR QUALITY REVIEW

As required by the OMP, air monitoring was conducted at one upwind and three downwind locations during each thermal treatment event. The samples were analyzed for selected metals [i.e., aluminum (Al), chromium (Cr), and lead (Pb)], ammonia (NH_3), carbon monoxide (CO), hydrochloric acid (HCL), and total suspended particulates (TSP). The monitoring results are included in Appendix B. In addition, plume temperature, plume height, and plume spread (lateral and vertical) were measured during each burn. Wind speed, wind direction, and ambient temperature were also measured during the burns. Real time weather monitoring was performed to determine

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whether conditions were safe to conduct thermal treatment, and to confirm that there were no significant shifts in wind direction during air sampling and the most downwind sampling locations were sampled. A summary of these data is included as Table A-1 of Appendix A.

Volatile Organic Compounds (VOCs) were required to be collected for a minimum of one year under the OMP. Any volatile organic shown to be present in excess of 100 parts per billion (ppb) during the first year would continue to be sampled thereafter. Volatile organics were not detected in excess of 100 ppb during the first year; therefore, they were not monitored following the burn event of April 8, 1992. Hence, VOCs are not included in this annual report.

The downwind locations were compared to the upwind locations to determine whether air quality has been impacted. To evaluate the air monitoring results, a one-tailed t-test (Sokal and Rohlf 1981, p. 231) was used to determine whether the upwind concentration was significantly lower than the mean downwind concentration at the 99 percent confidence level. Results of the statistical evaluation for general chemistry and metals are presented in Appendix B. Sample concentrations below the detection limit are indicated by a "<" notation with the detection limit, and a value of one-half the detection limit was used for the t-test.

The statistical evaluation began with calculating the mean (M) and the standard deviation (S) of the downwind concentrations. The equations used for these calculations were as follows:

$$M = (X1+X2+..Xn)/n$$

where, X = the downward concentration,
n = the total number of downwind concentrations.
$S = \text{Square root of } [\Sigma (Xi - M)^2/n]$

The mean and the standard deviation were then used to determine the sample t-value (ts), as follows:

$$ts = (U-M)/(S*[n+1)/n]^{1/2})$$

where, U = the upwind concentration

The sample t-value is used in comparison with the critical t-value (tc) to determine if the upwind and the downwind samples are from the same population. If the calculated

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sample t-value is less than the critical t-value then the upwind and downwind means are found to be not significantly different. To determine the critical t-value, the degree of freedom (df) must be determined as follows:

$$df = n - 1$$

The critical t-values at a 99 percent confidence are as follows:

df	tc
1	31.821
2	6.965

The statistical evaluations of the analytical results for the monitored parameters for each of the four (4) thermal treatment events conducted during this reporting period have indicated that the downwind locations are in the same statistical population as the upwind location, with all downwind results estimated not likely to exceed the background/upwind location or not significant because the constituents were below detection limits, for all monitored parameters.

Upon consideration of the weather data collected for each of the eleven (11) treatment events conducted during the annual reporting period, it was confirmed for all of the burns except 326A, 333A, and 334A that there were no significant shifts in wind direction during air sampling and the most downwind sampling locations were sampled. Because the statistical evaluations for those eight (8) thermal treatment events conducted during this reporting period (which consider all three downwind locations) are considered valid, and because those evaluations have indicated that the downwind locations are in the same statistical populations as the upwind locations, Aerojet Rocketdyne believes that the data was conclusive that air quality was not adversely impacted for eight (8) of the eleven (11) thermal treatment events conducted during this period (Burns 326B, 328A, 329A, 330A, 330B, 331A, 331B, and 336A).

For Burns 326A and 333A, because of high variability in wind direction and/or a significant unpredicted change in wind direction after the start of air monitoring, respectively, the most direct downwind locations were not sampled. For Burn 334A, wind direction was only approximated due to malfunction of the weather station (repaired prior to the next treatment event). Therefore, for Burns 326A, 333A, and 334A, it could not be determined with any certainty that the data was totally conclusive that air quality was not adversely impacted for the monitored parameters.

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Specific information for each thermal treatment event during the reporting period has been included in the quarterly air monitoring reports previously submitted. Both the general chemistry/metal (monitoring) results and statistical evaluations for all the burn events during this reporting period are included in Appendix B.

REFERENCES

Sensitivity Analysis and Identification of Reasonable Worst-Case Scenario Based on Air Dispersion Modeling for the Atlantic Research Corporation, Orange County, Virginia Facility. ARC. September 7, 1990.

Risk Assessment for the ARC Orange County Facility, Human Health Risk Due to Inhalation of Airborne Contaminants. Versar. September 15, 1990.

Sokal, R.R. and F.J. Rohlf. Biometry. 1981. W.H. Freeman and Company. New York, New York.

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November 20, 2017

CERTIFICATION LETTER

Dear Sirs:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

The document certified by this letter is the "27th Annual Air Monitoring Report Pursuant to the RCRA Research, Development, and Demonstration (RD&D) Permit for the Aerojet Rocketdyne, Inc., Orange County, Virginia Facility, EPA ID No. VAD981112618", dated November 20, 2017.

Very Truly Yours,

AEROJET ROCKETDYNE, INC.

Chris Widmot for BRIAN WHEATLEY for CHRIS CONLEY
11/20/17 (see attached delegation of authority memo)

Chris W. Conley
V.P. of Environmental, Health & Safety

AEROJET ROCKETDYNE
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Memo

June 1, 2015

To: Brian Wheatley

From: Chris W. Conley
Vice President, Environmental Health and Safety

Subject: Delegation of Authority

Copies: Brian Sweeney, Chris Cambria, William Hvidsten, Ron Felix, Tom Cadwell, Tim Holden, David Rymph, Ron Sherer, Jan DeMeulenaere

Reference: (a) Memorandum, Chairman of the Board, Aerojet-General Corporation, to President, Aerojet-General Corporation, dated January 7, 1985
(b) Memorandum, Office of the President, Aerojet-General Corporation, to Vice President, Environmental Health and Safety, Aerojet-General Corporation, dated October 21, 2008

Pursuant to the delegation of authority established by reference (a) and (b), authority is further re-delegated to Brian Wheatley to execute all agreements and documents related to permit applications, reports or other information submitted to regulatory agencies on behalf of Aerojet Rocketdyne, Inc. and pertaining to its Environmental, Health and Safety functions at the Orange, VA facility.

This authority does not extend to documents expressly requiring a Aerojet Rocketdyne Holdings, Inc. Corporate Officer's signature and is subject to legal or other reviews and approvals required by Aerojet Rocketdyne Holdings, Inc. and Aerojet Rocketdyne Leadership Media. This supersedes all previous delegations that you may have received relative to signature authority on third party documents.

This authority may be re-delegated subject to such limitations as deemed advisable. Please make all subsequent delegations in duplicate originals, furnishing one to the addressee and one to the Aerojet Rocketdyne Legal Department.

Chris W. Conley
Vice President
Environmental Health and Safety

AEROJET ROCKETDYNE

Memo

November 20, 2017

To: Distribution

From: Brian Wheatley

Subject: Delegation of Authority – November 20-22, 2017

During my absence from the plant November 20-22, Chris Wilmot will be in charge of routine plant operations on November 20-21.

Ernie Geiman will be in charge of routine plant operations on November 22.

Please see Tim Holden or Robert Payne for safety issues or in the event of a plant-wide issue or emergency.

Tim Holden: November 20-21
Robert Payne: November 22

Any document that is signed on my behalf must have this letter of delegation attached.

BW/tw

Distribution:

M. Morales
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Appendix A

Table A - 1. Monitored Inpuff 2.2 Parameters
Table A - 2. Comparison of Modeling and Monitoring Parameters

Table A.1 Monitored Inpuff 2.2 Parameters, Aerojet Culpeper Facility, Annual Report 2017

	10/04/16		10/11/16	12/14/16		01/25/17	02/15/17	02/28/17	03/16/17
Parameters	**Burn 326A**		**Burn 326B**	**Burn 328A**		**Burn 329A**	**Burn 330A**	**Burn 330B**	**Burn 331A**
	TTU 1	TTU 2	TTU 2	TTU 1	TTU 2	TTU 2	TTU 2	TTU 2	TTU 2
Weight of Burn (lbs)	3	4,400	120	87	1,628	312.1	403.56	4,091	1,062.5
Plume Temperature, max (C)	1,377	1,377	764	877	877	737	1,263	1,140	1,150
Time Pit Ignited	3:30 PM	3:30 PM	12:30 PM	2:00 PM	2:00 PM	1:15 PM	1:00 PM	1:50 PM	1:50 PM
Weather Observation	Clear	Clear	Clear	Clear	Clear	Clear	Scattered Clouds	Scattered Clouds	Clear
Ceiling Height (m)	5,000	5,000	5,000	5,000	5,000	5,000	1,800	3,700	5,000
Altitude of Sun (degrees)	34.9	34.9	43.9	23.1	23.1	31.8	38.8	40.0	49.8
Insolation Class	3	3	3	2	2	2	3	3	3
Net Radiation Index	3	3	3	2	2	2	3	3	3
Wind Speed (m/s)	0.72	0.72	1.83	3.20	3.20	3.20	4.22	7.61	3.33
Wind Direction (degree from North)	84	84	43	177	177	171	357	207	342
PG Stability Class	B	B	B	C	C	C	C	D	C
Ambient Temperature (C)	20.92	20.92	15.78	7.37	7.37	16.48	10.5	19.48	4.06
Plume Height (ft)	367.3	367.3	223.72	1192.5	1192.5	224	584	407.26	443
Plume Height (m)	111.95	111.95	68.19	363.46	363.46	68.27	177.99	124.13	135.02
Top of Plume Angle, degrees	24	24	15	55	55	15	35	26	28
Top of Plume Angle, Radians	0.41888	0.41888	0.26180	0.95993	0.95993	0.26180	0.61087	0.45379	0.48869
Width of Plume Angle, degrees	26	26	9	23	23	20	34	6	8
Width of Plume Angle, Radians	0.45379	0.45379	0.15708	0.40143	0.40143	0.34907	0.59341	0.10472	0.13963
Width of Plume (m)	116.10	116.10	40.06	103.56	103.56	89.85	155.44	26.68	35.51
Downwind distance, x (m)	251	251	254	254	254	255	254	254	254
Downwind distance, x (km)	0.251	0.251	0.254	0.254	0.254	0.255	0.254	0.254	0.254
Plume Spread - Lateral (sigma y) (m)	44.50	44.50	44.98	29.48	29.48	29.51	29.45	19.43	29.42
Plume Spread - Vertical (sigma z) (m)	25.34	25.34	25.64	17.49	17.49	17.51	17.47	10.48	17.45
PG Stability Class - Lateral (sigma y)	B	B	B	C	C	C	C	D	C
PG Stability Class - Vertical (sigma z)	B	B	B	C	C	C	C	D	C
Duration of Burn (Hr:Min:Sec)	0:15:00	0:15:00	0:07:00	0:15:00	0:15:00	0:15:00	0:10:00	0:15:00	0:07:00

Note:

[a]Wind speed and direction equipment were malfunctioning at the time of burn initiation. A windspeed of 0 knots was reported at the Orange County airport (KOMH) at the time of burn initiation.

PG Stability Classes:

A - Extremely to moderately unstable
B - Moderately unstable
C - Slightly unstable
D - Natural
E - Slightly stable
F - Moderately stable

Table A.1 Monitored Inpuff 2.2 Parameters, Aerojet Culpeper Facility, Annual Report 2017

	03/30/17	05/10/17	06/21/17	08/23/17
Parameters	**Burn 331B**	**Burn 333A**	**Burn 334A**	**Burn 336A**
	TTU 2	TTU 2	TTU 2	TTU 2
Weight of Burn (lbs)	494.5	2,618	2,269	2,258.11
Plume Temperature, max (C)	977	1,178	1,192	1,075
Time Pit Ignited	1:35 PM	2:00 PM	1:15 PM	1:05 PM
Weather Observation	Overcast	Scattered Clouds	Mostly Cloudy	Overcast
Ceiling Height (m)	1,400	2,100	2,400	2,100
Altitude of Sun (degrees)	55.6	66.7	75.2	62.9
Insolation Class	3	4	4	4
Net Radiation Index	1	4	2	3
Wind Speed (m/s)	4.11	1.27	0[a]	1.48
Wind Direction (degree from North)	180	82	0[a]	77
PG Stability Class	D	A	B	D
Ambient Temperature (C)	10.54	21.07	29.11	28
Plume Height (ft)	389	223.74	255.28	337
Plume Height (m)	118.56	68.19	77.81	102.71
Top of Plume Angle, degrees	25	15	17	22
Top of Plume Angle, Radians	0.43633	0.26180	0.29671	0.38397
Width of Plume Angle, degrees	7	4	7	9
Width of Plume Angle, Radians	0.12217	0.06981	0.12217	0.15708
Width of Plume (m)	31.10	17.77	31.13	40.02
Downwind distance, x (m)	254	254	254	254
Downwind distance, x (km)	0.254	0.254	0.254	0.254
Plume Spread - Lateral (sigma y) (m)	19.42	61.97	44.99	19.41
Plume Spread - Vertical (sigma z) (m)	10.47	38.44	25.64	10.47
PG Stability Class - Lateral (sigma y)	D	A	B	D
PG Stability Class - Vertical (sigma z)	D	A	B	D
Duration of Burn (Hr:Min:Sec)	0:12:00	0:15:00	0:15:00	0:17:00

Note:

[a]Wind speed and direction equipment were malfunctioning at the time of burn initiation. A windspeed of 0 knots was reported at the Orange County airport (KOMH) at the time of burn initiation.

PG Stability Classes:

A - Extremely to moderately unstable
B - Moderately unstable
C - Slightly unstable
D - Natural
E - Slightly stable
F - Moderately stable

Table A-2. Comparison of Modeling and Monitoring Parameters, Annual Report 2017

Parameters	INPUFF 2.2 MODEL (far field, near field)	ACTUAL MONITORED CONDITIONS
Carbon Monoxide (ppm)	4.75	0.24 - 0.96
Weight of Burn (lb.)	1000, 7000	120 - 4,403
Plume Temperature (C) (Max)	NA	737 - 1,377
Ambient Temperature (C)	NA	4.06 - 29.11
Plume Height (m)	50, 60	68.19 - 363.46
Plume Spread - Lateral (sigma y) (m)	14, 35	19.41 - 61.97
Plume Spread - Vertical (sigma z) (m)	14, 14	10.47 - 38.44
Wind Speed (m/s)	1 - 4.5	0 - 7.61
PG Stability Class	A, B	A - D
Duration of Burn (Min:Sec)	1:00	7:00 - 17:00

PG Stability Classes:

A - Extremely to moderately unstable
B - Moderately unstable
C - Slightly unstable
D - Neutral
E - Slightly stable
F - Moderately stable

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Appendix B

GENERAL CHEMISTRY AND METALS RESULTS AND STATISTICAL EVALUATIONS

AEROJET ROCKETDYNE
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AEROJET ROCKETDYNE, INC.
ORANGE COUNTY FACILITY

BURN 326A
OCTOBER 4, 2016

BURN 326B
OCTOBER 11, 2016

November 9, 2016

Mr. Tim Holden
Environmental Manager
Aerojet Corporation
7499 Pine Stake Road
Culpeper, VA 20155

Subject: Burns 326A and 326B Statistical Report, Versar Project No. 112133

Dear Mr. Holden:

Enclosed please find General Chemistry Results and Statistical Evaluations for Burn 326A and Burn 326B conducted on October 4 and 11, 2016. All results were estimated as not likely to exceed background or as not significant because the constituents were not detected (e.g., hydrogen chloride).

Should you have any questions, please do not hesitate to contact me at (703) 642-6842.

Sincerely,

H. Clarkson Meredith, III
Project Manager
Springfield Environmental Services Group

Enclr.

VERSAR
6850 Versar Center
Springfield, VA 22151
703.750.3000
www.versar.com

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 326A - Statistical Evaluation
October 4, 2016

BURN 326A RAW FIELD DATA AND LABORATORY RESULTS

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/sample)	HCl in air (ug/sample)	Al (ug/sample)	Cr (ug/sample)	Pb (ug/sample)	CO (ppm)	Total Suspended Particulates (TSP) (mg) after	(mg) before	(mg/sample) mass
II-326A	Upwind	8.81	5 <	91.3	0.505	1.97 <	0.83	4,581.5	4,580.3	1.2
LL-326A	Downwind	8.40	5 <	141	0.489	1.95 <	0.62	4,585.5	4,584.0	1.5
DD-326A	Downwind	30.9	5 <	113	0.448	1.97 <	0.59	4,584.0	4,583.3	0.7
BB-326A	Downwind	23.8	5 <	125	0.437	1.99 <	0.75	4,596.2	4,594.2	2.0

		NH3-N VOLUMES (L)	HCl in air VOLUMES (L)	Metals & TSP VOLUMES (ft^3)	CO Volumes (L)
II-326A	Upwind	18.216	36.234	3,600	8.9946
LL-326A	Downwind	18.216	36.27	3,600	8.9964
DD-326A	Downwind	18.306	36.18	3,600	8.9946
BB-326A	Downwind	18.270	36.27	3,600	8.9937

< - Denotes constituent not detected. Value is the analytical reporting limit.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 326A - Statistical Evaluation
October 4, 2016

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/m3)		HCl in air (ug/m3)	Al (ug/m3)	Cr (ug/m3)		Pb (ug/m3)	CO (ppm)	TSP (ug/m3)
BURN 326A										
II-326A	Upwind	483.6	<	138.0	0.90	0.005	<	0.00968	0.83	11.8
LL-326A	Downwind	461.1	<	137.9	1.39	0.005	<	0.00958	0.62	14.7
DD-326A	Downwind	1688.0	<	138.2	1.11	0.004	<	0.00968	0.59	6.9
BB-326A	Downwind	1302.7	<	137.9	1.23	0.004	<	0.00978	0.75	19.6

NOTES:
< = Not detected.

	NH3-N	HCl in air	Al	Cr	Pb	CO	TSP
COUNT:	3	3	3	3	3	3	3
MEAN DOWNWIND CONC.:	1151	69.0	1.24	0.00	0.0048	0.653	13.8
STANDARD DEVIATION:	512	0.08	0.11	0.000	0.0001	0.069	5.3
SQRT(N+1/n):	1.15	1.15	1.15	1.15	1.15	1.15	1.15
SAMPLE t VALUE:	1.13	0.12	2.65	1.82	0.0	2.20	0.32
DEGREE OF FREEDOM:	2	2	2	2	2	2	2
CRITICAL t VALUE:	6.965	6.965	6.965	6.965	6.965	6.965	6.965
COMMENTS:	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN

NOTES:
NOT SIGN = Not Significant. Population mean of downwind concentrations likely does not exceed upwind concentrations.
*NOT SIGN = Not Significant. All downwind samples results were below the reporting limit.
SIGNIFICANT = Population mean of downwind concentrations likely exceeds the upwind concentration.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 326B - Statistical Evaluation
October 11, 2016

BURN 326A RAW FIELD DATA AND LABORATORY RESULTS

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/sample)	HCl in air (ug/sample)	Al (ug/sample)	Cr (ug/sample)	Pb (ug/sample)	CO (ppm)	Total Suspended Particulates (TSP) (mg) after	(mg) before	(mg/sample) mass
HH-326B	Upwind	5.72	5 <	107	0.437	1.96 <	0.71	4,574.2	4,573.5	0.7
EE-326B	Downwind	16.4	5 <	131	0.443	1.98 <	0.59	4,569.2	4,568.4	0.8
LL-326B	Downwind	10.0	5 <	154	0.426	1.97 <	0.81	4,563.4	4,562.3	1.1
CC-326B	Downwind	8.35	5 <	120	0.419	1.96 <	0.68	4,561.9	4,561.1	0.8

		NH3-N VOLUMES (L)	HCl in air VOLUMES (L)	Metals & TSP VOLUMES (ft^3)	CO Volumes (L)
HH-326B	Upwind	18.216	36.234	3,600	8.9946
EE-326B	Downwind	18.252	36.27	3,600	8.9944
LL-326B	Downwind	18.306	36.18	3,600	8.9964
CC-326B	Downwind	18.252	36.27	3,600	8.9928

< - Denotes constituent not detected. Value is the analytical reporting limit.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 326B - Statistical Evaluation
October 11, 2016

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/m3)		HCl in air (ug/m3)	Al (ug/m3)	Cr (ug/m3)		Pb (ug/m3)	CO (ppm)	TSP (ug/m3)
BURN 326A										
HH-326B	Upwind	314.0	<	138.0	1.05	0.004	<	0.00963	0.71	6.9
EE-326B	Downwind	898.5	<	137.9	1.29	0.004	<	0.00973	0.59	7.9
LL-326B	Downwind	546.3	<	138.2	1.51	0.004	<	0.00968	0.81	10.8
CC-326B	Downwind	457.5	<	137.9	1.18	0.004	<	0.00963	0.68	7.9

NOTES:
< = Not detected.

	NH3-N	HCl in air	Al	Cr	Pb	CO	TSP
COUNT:	3	3	3	3	3	3	3
MEAN DOWNWIND CONC.:	634	69.0	1.33	0.00	0.0048	0.693	8.8
STANDARD DEVIATION:	190	0.08	0.14	0.000	0.0000	0.090	1.4
SQRT(N+1/n):	1.15	1.15	1.15	1.15	1.15	1.15	1.15
SAMPLE t VALUE:	1.46	0.12	1.71	0.66	0.4	0.16	1.22
DEGREE OF FREEDOM:	2	2	2	2	2	2	2
CRITICAL t VALUE:	6.965	6.965	6.965	6.965	6.965	6.965	6.965
COMMENTS:	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN

NOTES:
NOT SIGN = Not Significant. Population mean of downwind concentrations likely does not exceed upwind concentrations.
*NOT SIGN = Not Significant. All downwind samples results were below the reporting limit.
SIGNIFICANT = Population mean of downwind concentrations likely exceeds the upwind concentration.

7499 Pine Stake Road
Culpeper, VA 22701

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Fax: 540-854-2002

AEROJET ROCKETDYNE, INC.
ORANGE COUNTY FACILITY

BURN 328A
DECEMBER 14, 2016

BURN 329A
JANUARY 25, 2017

March 28, 2017

Mr. Tim Holden
Environmental Manager
Aerojet Corporation
7499 Pine Stake Road
Culpeper, VA 20155

Subject: Burns 328A and 329A Statistical Report, Versar Project No. 112133

Dear Mr. Holden:

Enclosed please find General Chemistry Results and Statistical Evaluations for Burn 330A and Burn 330B conducted on 328A conducted on December 14, 2016 and Burn 329A conducted on January 25, 2017. All results were estimated as not likely to exceed background or as not significant because the constituents were not detected (e.g., hydrogen chloride).

Should you have any questions, please do not hesitate to contact me at (703) 642-6842.

Sincerely,

H. Clarkson Meredith, III
Project Manager
Springfield Environmental Services Group

Enclr.

VERSAR
6850 Versar Center
Springfield, VA 22151
703.750.3000
www.versar.com

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 328A - Statistical Evaluation
December 14, 2016

BURN 328A RAW FIELD DATA AND LABORATORY RESULTS

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/sample)	HCl in air (ug/sample)	Al (ug/sample)	Cr (ug/sample)	Pb (ug/sample)	CO (ppm)	Total Suspended Particulates (TSP) (mg) after	(mg) before	(mg/sample) mass
LL-328A	Upwind	5.46	5 <	108	0.427	1.97 <	0.24	4,574.2	4,573.8	0.4
EE-328A	Downwind	7.47	5 <	139	0.563	1.99 <	0.28	4,557.0	4,555.5	1.5
II-328A	Downwind	4.96	5 <	141	1.13	1.98 <	0.26	4,575.2	4,574.7	0.5
HH-328A	Downwind	9.65	5 <	104	0.466	1.97 <	0.64	4,565.8	4,564.8	1.0

		NH3-N VOLUMES (L)	HCl in air VOLUMES (L)	Metals & TSP VOLUMES (ft^3)	CO Volumes (L)
LL-328A	Upwind	18.216	36.324	3,600	8.9946
EE-328A	Downwind	18.234	36.234	3,200	8.9946
II-328A	Downwind	18.324	36.216	3,600	8.9946
HH-328A	Downwind	18.252	36.270	3,600	8.9982

< - Denotes constituent not detected. Value is the analytical reporting limit.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 328A - Statistical Evaluation
December 14, 2016

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/m3)		HCl in air (ug/m3)	Al (ug/m3)	Cr (ug/m3)		Pb (ug/m3)	CO (ppm)	TSP (ug/m3)
BURN 328A										
LL-328A	Upwind	299.7	<	137.7	1.06	0.004	<	0.00968	0.24	3.9
EE-328A	Downwind	409.7	<	138.0	1.54	0.006	<	0.01100	0.28	16.6
II-328A	Downwind	270.7	<	138.1	1.39	0.011	<	0.00973	0.26	4.9
HH-328A	Downwind	528.7	<	137.9	1.02	0.005	<	0.00968	0.64	9.8

NOTES:
< = Not detected.

	NH3-N	HCl in air	Al	Cr	Pb	CO	TSP
COUNT:	3	3	3	3	3	3	3
MEAN DOWNWIND CONC.:	403	69.0	1.31	0.01	0.0050	0.393	10.4
STANDARD DEVIATION:	105	0.04	0.22	0.003	0.0006	0.175	4.8
SQRT(N+1/n):	1.15	1.15	1.15	1.15	1.15	1.15	1.15
SAMPLE t VALUE:	0.85	3.23	1.02	0.97	0.2	0.76	1.18
DEGREE OF FREEDOM:	2	2	2	2	2	2	2
CRITICAL t VALUE:	6.965	6.965	6.965	6.965	6.965	6.965	6.965
COMMENTS:	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN

NOTES:
NOT SIGN = Not Significant. Population mean of downwind concentrations likely does not exceed upwind concentrations.
*NOT SIGN = Not Significant. All downwind samples results were below the reporting limit.
SIGNIFICANT = Population mean of downwind concentrations likely exceeds the upwind concentration.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 329A - Statistical Evaluation
January 25, 2017

BURN 329A RAW FIELD DATA AND LABORATORY RESULTS

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/sample)	HCl in air (ug/sample)	Al (ug/sample)	Cr (ug/sample)	Pb (ug/sample)	CO (ppm)	Total Suspended Particulates (TSP) (mg) after	(mg) before	(mg/sample) mass
LL-329A	Upwind	7.42	5 <	96.5	0.520	1.97 <	0.63	4,575.2	4,574.0	1.2
EE-329A	Downwind	4.99	5 <	93.3	0.454	1.98 <	0.81	4,551.9	4,550.8	1.1
II-329A	Downwind	17.80	5 <	67.6	0.440	1.97 <	0.71	4,580.4	4,580.0	0.4
HH-329A	Downwind	6.05	5 <	80.0	0.345	1.94 <	0.92	4,575.5	4,575.2	0.3

		NH3-N VOLUMES (L)	HCl in air VOLUMES (L)	Metals & TSP VOLUMES (ft^3)	CO Volumes (L)
LL-329A	Upwind	18.270	36.270	3,600	8.9892
EE-329A	Downwind	18.306	36.360	3,600	8.9964
II-329A	Downwind	18.270	36.414	3,600	8.9964
HH-329A	Downwind	18.306	36.306	3,600	8.9892

< - Denotes constituent not detected. Value is the analytical reporting limit.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 329A - Statistical Evaluation
January 25, 2017

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/m3)		HCl in air (ug/m3)	Al (ug/m3)	Cr (ug/m3)		Pb (ug/m3)	CO (ppm)	TSP (ug/m3)
BURN 329A										
LL-329A	Upwind	406.1	<	137.9	0.95	0.005	<	0.00968	0.63	11.8
EE-329A	Downwind	272.6	<	137.5	0.92	0.004	<	0.00973	0.81	10.8
II-329A	Downwind	974.3	<	137.3	0.66	0.004	<	0.00968	0.71	3.9
HH-329A	Downwind	330.5	<	137.7	0.79	0.003	<	0.00953	0.92	2.9

NOTES:
< = Not detected.

	NH3-N	HCl in air	Al	Cr	Pb	CO	TSP
COUNT:	3	3	3	3	3	3	3
MEAN DOWNWIND CONC.:	526	68.8	0.79	0.00	0.0048	0.813	5.9
STANDARD DEVIATION:	318	0.08	0.10	0.000	0.0001	0.086	3.5
SQRT(N+1/n):	1.15	1.15	1.15	1.15	1.15	1.15	1.15
SAMPLE t VALUE:	0.33	1.77	1.34	1.91	0.1	1.85	1.46
DEGREE OF FREEDOM:	2	2	2	2	2	2	2
CRITICAL t VALUE:	6.965	6.965	6.965	6.965	6.965	6.965	6.965
COMMENTS:	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN

NOTES:
NOT SIGN = Not Significant. Population mean of downwind concentrations likely does not exceed upwind concentrations.
*NOT SIGN = Not Significant. All downwind samples results were below the reporting limit.
SIGNIFICANT = Population mean of downwind concentrations likely exceeds the upwind concentration.

AEROJET ROCKETDYNE
Ideas Powering Freedom

7499 Pine Stake Road
Culpeper, VA 22701

Tel: 540-854-2000
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AEROJET ROCKETDYNE, INC.
ORANGE COUNTY FACILITY

BURN 330A
FEBRUARY 15, 2017

BURN 330B
FEBRUARY 28, 2017

March 28, 2017

Mr. Tim Holden
Environmental Manager
Aerojet Corporation
7499 Pine Stake Road
Culpeper, VA 20155

Subject: Burns 330A and 330B Statistical Report, Versar Project No. 112133

Dear Mr. Holden:

Enclosed please find General Chemistry Results and Statistical Evaluations for Burn 330A and Burn 330B conducted on February 15 and 28, 2018. All results were estimated as not likely to exceed background or as not significant because the constituents were not detected (e.g., hydrogen chloride).

Should you have any questions, please do not hesitate to contact me at (703) 642-6842.

Sincerely,

H. Clarkson Meredith, III
Project Manager
Springfield Environmental Services Group

Enclr.

VERSAR
6850 Versar Center
Springfield, VA 22151
703.750.3000
www.versar.com

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 330A - Statistical Evaluation
February 15, 2017

BURN 330A RAW FIELD DATA AND LABORATORY RESULTS

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/sample)	HCl in air (ug/sample)	Al (ug/sample)	Cr (ug/sample)	Pb (ug/sample)	CO (ppm)	Total Suspended Particulates (TSP) (mg) after	(mg) before	(mg/sample) mass
EE-330A	Upwind	2.99	5 <	84.4	0.361	1.93 <	0.37	4,573.2	4,572.2	1.0
BB-330A	Downwind	7.17	5 <	84.2	0.380	1.92 <	0.44	4,572.0	4,569.5	2.5
AA-330A	Downwind	4.99	5 <	69.6	0.385	1.96 <	0.43	4,558.9	4,556.6	2.3
HH-330A	Downwind	3.74	5 <	99.2	0.461	1.91 <	0.30	4,558.9	4,558.1	0.8

		NH3-N VOLUMES (L)	HCl in air VOLUMES (L)	Metals & TSP VOLUMES (ft^3)	CO Volumes (L)
EE-330A	Upwind	18.270	36.270	3,600	8.9946
BB-330A	Downwind	18.306	36.360	3,600	8.9964
AA-330A	Downwind	18.234	36.342	3,600	8.9964
HH-330A	Downwind	18.306	36.324	3,600	8.9910

< - Denotes constituent not detected. Value is the analytical reporting limit.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 330A - Statistical Evaluation
February 15, 2017

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/m3)		HCl in air (ug/m3)	Al (ug/m3)	Cr (ug/m3)		Pb (ug/m3)	CO (ppm)	TSP (ug/m3)
BURN 330A										
EE-330A	Upwind	163.7	<	137.9	0.83	0.004	<	0.00948	0.37	9.8
BB-330A	Downwind	391.7	<	137.5	0.83	0.004	<	0.00943	0.44	24.6
AA-330A	Downwind	273.7	<	137.6	0.68	0.004	<	0.00963	0.43	22.6
HH-330A	Downwind	204.3	<	137.7	0.97	0.005	<	0.00938	0.30	7.9

NOTES:
< = Not detected.

	NH3-N	HCl in air	Al	Cr	Pb	CO	TSP
COUNT:	3	3	3	3	3	3	3
MEAN DOWNWIND CONC.:	290	68.8	0.83	0.00	0.0047	0.390	18.3
STANDARD DEVIATION:	77	0.03	0.12	0.000	0.0001	0.064	7.5
SQRT(N+1/n):	1.15	1.15	1.15	1.15	1.15	1.15	1.15
SAMPLE t VALUE:	1.41	4.25	0.00	1.11	0.0	0.27	0.99
DEGREE OF FREEDOM:	2	2	2	2	2	2	2
CRITICAL t VALUE:	6.965	6.965	6.965	6.965	6.965	6.965	6.965
COMMENTS:	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN

NOTES:
NOT SIGN = Not Significant. Population mean of downwind concentrations likely does not exceed upwind concentrations.
*NOT SIGN = Not Significant. All downwind samples results were below the reporting limit.
SIGNIFICANT = Population mean of downwind concentrations likely exceeds the upwind concentration.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 330B - Statistical Evaluation
February 28, 2017

BURN 330B RAW FIELD DATA AND LABORATORY RESULTS

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/sample)	HCl in air (ug/sample)	Al (ug/sample)	Cr (ug/sample)	Pb (ug/sample)	CO (ppm)	Total Suspended Particulates (TSP) (mg) after	(mg) before	(mg/sample) mass
DD-330B	Upwind	5.53	5 <	83	0.277	2.00 <	0.38	4,560.2	4,557.9	2.3
EE-330B	Downwind	5.82	5 <	208	0.601	1.98 <	0.40	4,574.4	4,571.0	3.4
II-330B	Downwind	5.72	5 <	119	0.390	1.97 <	0.43	4,569.5	4,566.3	3.2
HH-330B	Downwind	11.00	5 <	120	0.358	1.97 <	0.44	4,567.2	4,563.6	3.6

		NH3-N VOLUMES (L)	HCl in air VOLUMES (L)	Metals & TSP VOLUMES (ft^3)	CO Volumes (L)
DD-330B	Upwind	18.234	36.270	3,600	8.9964
EE-330B	Downwind	18.306	36.360	3,600	8.9946
II-330B	Downwind	18.270	36.324	3,600	8.9946
HH-330B	Downwind	18.306	36.360	3,600	9.0000

< - Denotes constituent not detected. Value is the analytical reporting limit.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 330B - Statistical Evaluation
February 28, 2017

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/m3)		HCl in air (ug/m3)	Al (ug/m3)	Cr (ug/m3)		Pb (ug/m3)	CO (ppm)	TSP (ug/m3)
BURN 330B										
DD-330B	Upwind	303.3	<	137.9	0.82	0.003	<	0.00982	0.38	22.6
EE-330B	Downwind	317.9	<	137.5	2.04	0.006	<	0.00973	0.40	33.4
II-330B	Downwind	313.1	<	137.7	1.17	0.004	<	0.00968	0.43	31.4
HH-330B	Downwind	600.9	<	137.5	1.18	0.004	<	0.00968	0.44	35.4

NOTES:
< = Not detected.

	NH3-N	HCl in air	Al	Cr	Pb	CO	TSP
COUNT:	3	3	3	3	3	3	3
MEAN DOWNWIND CONC.:	411	68.8	1.46	0.00	0.0049	0.423	33.4
STANDARD DEVIATION:	135	0.03	0.41	0.001	0.0000	0.017	1.6
SQRT(N+1/n):	1.15	1.15	1.15	1.15	1.15	1.15	1.15
SAMPLE t VALUE:	0.69	3.99	1.37	1.39	1.8	2.21	5.83
DEGREE OF FREEDOM:	2	2	2	2	2	2	2
CRITICAL t VALUE:	6.965	6.965	6.965	6.965	6.965	6.965	6.965
COMMENTS:	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN

NOTES:
NOT SIGN = Not Significant. Population mean of downwind concentrations likely does not exceed upwind concentrations.
*NOT SIGN = Not Significant. All downwind samples results were below the reporting limit.
SIGNIFICANT = Population mean of downwind concentrations likely exceeds the upwind concentration.

7499 Pine Stake Road
Culpeper, VA 22701

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AEROJET ROCKETDYNE, INC.
ORANGE COUNTY FACILITY

BURN 331A
MARCH 16, 2017

BURN 331B
MARCH 30, 2017

BURN 333A
MAY 10, 2017

June 16, 2017

Mr. Tim Holden
Environmental Manager
Aerojet Corporation
7499 Pine Stake Road
Culpeper, VA 20155

Subject: Burns 331A, 331B and 333A Statistical Report, Versar Project No. 112133

Dear Mr. Holden:

Enclosed please find General Chemistry Results and Statistical Evaluations for Burn 331A conducted on March 16, 2017, Burn 331B conducted on March 30, 2017 and 333A conducted on May 10, 2017. All results were estimated as not likely to exceed background or as not significant because the constituents were not detected (e.g., hydrogen chloride).

Should you have any questions, please do not hesitate to contact me at (703) 642-6842.

Sincerely,

H. Clarkson Meredith, III
Project Manager
Springfield Environmental Services Group

Enclr.

VERSAR
6850 Versar Center
Springfield, VA 22151
703.750.3000
www.versar.com

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 331A - Statistical Evaluation
March 16, 2017

BURN 331A RAW FIELD DATA AND LABORATORY RESULTS

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/sample)	HCl in air (ug/sample)	Al (ug/sample)	Cr (ug/sample)	Pb (ug/sample)	CO (ppm)	Total Suspended Particulates (TSP) (mg) after	(mg) before	(mg/sample) mass
EE-331A	Upwind	6.17	5 <	95.5	0.400	1.96 <	0.41	4,566.5	4,554.5	12.0
AA-331A	Downwind	6.54	5 <	105	0.325	1.98 <	0.43	4,573.0	4,570.5	2.5
BB-331A	Downwind	4.75	5 <	68.4	0.254	1.94 <	0.47	4,564.9	4,563.4	1.5
CC-331A	Downwind	4.93	5 <	86.0	0.308	1.95 <	0.67	4,569.4	4,567.4	2.0

		NH3-N VOLUMES (L)	HCl in air VOLUMES (L)	Metals & TSP VOLUMES (ft^3)	CO Volumes (L)
EE-331A	Upwind	18.252	36.27	3,600	9.09
AA-331A	Downwind	18.270	36.36	3,600	9.00
BB-331A	Downwind	18.432	36.09	3,600	9.00
CC-331A	Downwind	18.360	36.36	3,600	9.00

< - Denotes constituent not detected. Value is the analytical reporting limit.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 331A - Statistical Evaluation
March 16, 2017

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/m3)		HCl in air (ug/m3)	Al (ug/m3)	Cr (ug/m3)		Pb (ug/m3)	CO (ppm)	TSP (ug/m3)
BURN 331A										
EE-331A	Upwind	338.0	<	137.9	0.94	0.004	<	0.00963	0.41	117.9
AA-331A	Downwind	358.0	<	137.5	1.03	0.003	<	0.00973	0.43	24.6
BB-331A	Downwind	257.7	<	138.5	0.67	0.002	<	0.00953	0.47	14.7
CC-331A	Downwind	268.5	<	137.5	0.84	0.003	<	0.00958	0.67	19.6

NOTES:
< = Not detected.

	NH3-N	HCl in air	Al	Cr	Pb	CO	TSP
COUNT:	3	3	3	3	3	3	3
MEAN DOWNWIND CONC.:	295	68.9	0.85	0.00	0.0048	0.523	19.6
STANDARD DEVIATION:	45	0.24	0.15	0.000	0.0001	0.105	4.0
SQRT(N+1/n):	1.15	1.15	1.15	1.15	1.15	1.15	1.15
SAMPLE t VALUE:	0.83	0.00	0.52	2.99	0.1	0.93	21.21
DEGREE OF FREEDOM:	2	2	2	2	2	2	2
CRITICAL t VALUE:	6.965	6.965	6.965	6.965	6.965	6.965	6.965
COMMENTS:	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN

NOTES:
NOT SIGN = Not Significant. Population mean of downwind concentrations likely does not exceed upwind concentrations.
*NOT SIGN = Not Significant. All downwind samples results were below the reporting limit.
SIGNIFICANT = Population mean of downwind concentrations likely exceeds the upwind concentration.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 331B - Statistical Evaluation
March 30, 2017

BURN 331B RAW FIELD DATA AND LABORATORY RESULTS

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/sample)	HCl in air (ug/sample)	Al (ug/sample)	Cr (ug/sample)	Pb (ug/sample)	CO (ppm)	Total Suspended Particulates (TSP) (mg) after	(mg) before	(mg/sample) mass
BB-331B	Upwind	7.72	5 <	100	0.406	1.90 <	0.65	4,573.6	4,572.0	1.6
EE-331B	Downwind	4.02	5 <	95.7	0.387	1.91 <	0.66	4,571.6	4,569.5	2.1
II-331B	Downwind	5.30	5 <	78.0	0.302	1.97 <	0.69	4,562.1	4,559.4	2.7
HH-331B	Downwind	5.58	5 <	64.2	0.345	1.94 <	0.79	4,543.4	4,542.4	1.0

		NH3-N VOLUMES (L)	HCl in air VOLUMES (L)	Metals & TSP VOLUMES (ft^3)	CO Volumes (L)
BB-331B	Upwind	18.234	36.270	3,600	9.180
EE-331B	Downwind	18.288	36.360	3,600	9.000
II-331B	Downwind	18.396	36.180	3,600	9.000
HH-331B	Downwind	18.360	36.324	3,600	9.054

< - Denotes constituent not detected. Value is the analytical reporting limit.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 331B - Statistical Evaluation
March 30, 2017

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/m3)		HCl in air (ug/m3)	Al (ug/m3)	Cr (ug/m3)		Pb (ug/m3)	CO (ppm)	TSP (ug/m3)
BURN 331B										
BB-331B	Upwind	423.4	<	137.9	0.98	0.004	<	0.00933	0.65	15.7
EE-331B	Downwind	219.8	<	137.5	0.94	0.004	<	0.00938	0.66	20.6
II-331B	Downwind	288.1	<	138.2	0.77	0.003	<	0.00968	0.69	26.5
HH-331B	Downwind	303.9	<	137.7	0.63	0.003	<	0.00953	0.79	9.8

NOTES:
< = Not detected.

	NH3-N	HCl in air	Al	Cr	Pb	CO	TSP
COUNT:	3	3	3	3	3	3	3
MEAN DOWNWIND CONC.:	271	68.9	0.78	0.00	0.0047	0.713	19.0
STANDARD DEVIATION:	36	0.15	0.13	0.000	0.0001	0.056	6.9
SQRT(N+1/n):	1.15	1.15	1.15	1.15	1.15	1.15	1.15
SAMPLE t VALUE:	3.63	0.20	1.39	1.53	0.5	0.99	0.41
DEGREE OF FREEDOM:	2	2	2	2	2	2	2
CRITICAL t VALUE:	6.965	6.965	6.965	6.965	6.965	6.965	6.965
COMMENTS:	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN

NOTES:
NOT SIGN = Not Significant. Population mean of downwind concentrations likely does not exceed upwind concentrations.
*NOT SIGN = Not Significant. All downwind samples results were below the reporting limit.
SIGNIFICANT = Population mean of downwind concentrations likely exceeds the upwind concentration.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 333A - Statistical Evaluation
May 10, 2017

BURN 333A RAW FIELD DATA AND LABORATORY RESULTS

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/sample)	HCl in air (ug/sample)	Al (ug/sample)	Cr (ug/sample)	Pb (ug/sample)	CO (ppm)	Total Suspended Particulates (TSP) (mg) after	(mg) before	(mg/sample) mass
II-333A	Upwind	10.40	5 <	60.0	0.311	1.93 <	0.86	4,557.3	4,556.3	1.0
BB-333A	Downwind	11.40	5 <	62.8	0.305	1.96 <	0.88	4,544.2	4,541.6	2.6
CC-333A	Downwind	5.79	5 <	63.3	0.334	1.93 <	0.96	4,565.2	4,563.2	2.0
DD-333A	Downwind	7.02	5 <	50.8	0.250	1.92 <	0.88	4,547.1	4,545.4	1.7

		NH3-N VOLUMES (L)	HCl in air VOLUMES (L)	Metals & TSP VOLUMES (ft^3)	CO Volumes (L)
II-333A	Upwind	18.216	36.234	3,600	9.180
BB-333A	Downwind	18.252	36.360	3,600	9.000
CC-333A	Downwind	18.324	36.180	3,600	9.000
DD-333A	Downwind	18.306	36.306	3,600	9.072

< - Denotes constituent not detected. Value is the analytical reporting limit.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 333A - Statistical Evaluation
May 10, 2017

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/m3)		HCl in air (ug/m3)	Al (ug/m3)	Cr (ug/m3)		Pb (ug/m3)	CO (ppm)	TSP (ug/m3)
BURN 333A										
II-333A	Upwind	570.9	<	138.0	0.59	0.003	<	0.00948	0.86	9.8
BB-333A	Downwind	624.6	<	137.5	0.62	0.003	<	0.00963	0.88	25.5
CC-333A	Downwind	316.0	<	138.2	0.62	0.003	<	0.00948	0.96	19.6
DD-333A	Downwind	383.5	<	137.7	0.50	0.002	<	0.00943	0.88	16.7

NOTES:
< = Not detected.

	NH3-N	HCl in air	Al	Cr	Pb	CO	TSP
COUNT:	3	3	3	3	3	3	3
MEAN DOWNWIND CONC.:	441	68.9	0.58	0.00	0.0048	0.907	20.6
STANDARD DEVIATION:	132	0.14	0.06	0.000	0.0001	0.038	3.7
SQRT(N+1/n):	1.15	1.15	1.15	1.15	1.15	1.15	1.15
SAMPLE t VALUE:	0.85	0.55	0.15	0.36	0.1	1.07	2.55
DEGREE OF FREEDOM:	2	2	2	2	2	2	2
CRITICAL t VALUE:	6.965	6.965	6.965	6.965	6.965	6.965	6.965
COMMENTS:	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN

NOTES:
NOT SIGN = Not Significant. Population mean of downwind concentrations likely does not exceed upwind concentrations.
*NOT SIGN = Not Significant. All downwind samples results were below the reporting limit.
SIGNIFICANT = Population mean of downwind concentrations likely exceeds the upwind concentration.

7499 Pine Stake Road
Culpeper, VA 22701

Tel: 540-854-2000
Fax: 540-854-2002

AEROJET ROCKETDYNE, INC.
ORANGE COUNTY FACILITY

BURN 334A
JUNE 21, 2017

BURN 336B
AUGUST 23, 2017

September 27, 2017

Mr. Tim Holden
Environmental Manager
Aerojet Corporation
7499 Pine Stake Road
Culpeper, VA 20155

Subject: Burns 334A and 336A Statistical Report: Versar Project No. 112133

Dear Mr. Holden:

Enclosed please find General Chemistry Results and Statistical Evaluations for Burn 334A conducted on June 21, 2017 and 336A conducted on August 23, 2017. All results were estimated as not likely to exceed background or as not significant because the constituents were not detected (e.g., hydrogen chloride).

Should you have any questions, please do not hesitate to contact me at (703) 642-6842.

Sincerely,

H. Clarkson Meredith, III
Sr. Project Manager
Springfield Environmental Services Group

Enclr.

VERSAR
6850 Versar Center
Springfield, VA 22151
703.750.3000
www.versar.com

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 334A - Statistical Evaluation
June 21, 2017

BURN 334A RAW FIELD DATA AND LABORATORY RESULTS

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/sample)	HCl in air (ug/sample)	Al (ug/sample)	Cr (ug/sample)	Pb (ug/sample)	CO (ppm)	Total Suspended Particulates (TSP) (mg) after	(mg) before	(mg/sample) mass
DD-334A	Upwind	8.98	5 <	178	0.591	1.95 <	0.72	4,552.8	4,550.9	1.9
EE-334A	Downwind	2.22	5 <	112	0.456	1.97 <	0.29	4,554.0	4,551.8	2.2
II-334A	Downwind	6.11	5 <	124	0.420	1.92 <	0.68	4,576.4	4,573.9	2.5
HH-334A	Downwind	7.46	5 <	138	0.629	1.98 <	0.70	4,533.5	4,530.8	2.7

		NH3-N VOLUMES (L)	HCl in air VOLUMES (L)	Metals & TSP VOLUMES (ft^3)	CO Volumes (L)
DD-334A	Upwind	18.234	36.234	3,600	9.180
EE-334A	Downwind	18.252	36.324	3,400	9.090
II-334A	Downwind	18.306	36.180	3,600	9.000
HH-334A	Downwind	18.306	36.288	3,600	9.054

< - Denotes constituent not detected. Value is the analytical reporting limit.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 336A - Statistical Evaluation
August 23, 2017

BURN 336A RAW FIELD DATA AND LABORATORY RESULTS

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/sample)	HCl in air (ug/sample)	Al (ug/sample)	Cr (ug/sample)	Pb (ug/sample)	CO (ppm)	Total Suspended Particulates (TSP) (mg) after	(mg) before	(mg/sample) mass
II-336A	Upwind	2.34	5 <	46.4	0.252	1.95 <	0.36	4,348.6	4,347.5	1.1
LL-336A	Downwind	3.04	5 <	46.8	0.239 <	1.91 <	0.49	4,339.0	4,337.3	1.7
CC-336A	Downwind	17.10	5 <	36.8	0.242 <	1.93 <	0.44	4,336.6	4,334.4	2.2
BB-336A	Downwind	14.70	5 <	48.8	0.244 <	1.96 <	0.77	4,347.7	4,346.9	0.8

		NH3-N VOLUMES (L)	HCl in air VOLUMES (L)	Metals & TSP VOLUMES (ft^3)	CO Volumes (L)
II-336A	Upwind	18.234	36.252	3,600	9.18
LL-336A	Downwind	18.234	36.234	3,600	9.13
CC-336A	Downwind	18.324	36.198	3,600	9.00
BB-336A	Downwind	18.306	36.270	3,600	9.07

< - Denotes constituent not detected. Value is the analytical reporting limit.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 336A - Statistical Evaluation
August 23, 2017

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/m3)		HCl in air (ug/m3)	Al (ug/m3)		Cr (ug/m3)		Pb (ug/m3)	CO (ppm)	TSP (ug/m3)
BURN 336A											
II-336A	Upwind	128.3	<	137.9	0.46		0.002	<	0.00958	0.36	10.8
LL-336A	Downwind	166.7	<	138.0	0.46	<	0.002	<	0.00938	0.49	16.7
CC-336A	Downwind	933.2	<	138.1	0.36	<	0.002	<	0.00948	0.44	21.6
BB-336A	Downwind	803.0	<	137.9	0.48	<	0.002	<	0.00963	0.77	7.9

NOTES:
< = Not detected.

	NH3-N	HCl in air	Al	Cr	Pb	CO	TSP
COUNT:	3	3	3	3	3	3	3
MEAN DOWNWIND CONC.:	634	69.0	0.43	0.00	0.0048	0.567	15.4
STANDARD DEVIATION:	335	0.06	0.05	0.000	0.0001	0.145	5.7
SQRT(N+1/n):	1.15	1.15	1.15	1.15	1.15	1.15	1.15
SAMPLE t VALUE:	1.31	0.53	0.37	4.36	0.3	1.23	0.70
DEGREE OF FREEDOM:	2	2	2	2	2	2	2
CRITICAL t VALUE:	6.965	6.965	6.965	6.965	6.965	6.965	6.965
COMMENTS:	NOT SIGN	*NOT SIGN	NOT SIGN	*NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN

NOTES:
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*NOT SIGN = Not Significant. All downwind samples results were below the reporting limit.
SIGNIFICANT = Population mean of downwind concentrations likely exceeds the upwind concentration.

AEROJET CORP., ORANGE COUNTY FACILITY
Burn 334A - Statistical Evaluation
June 21, 2017

SAMPLE NUMBER	SAMPLE LOCATION	NH3-N (ug/m3)		HCl in air (ug/m3)	Al (ug/m3)	Cr (ug/m3)		Pb (ug/m3)	CO (ppm)	TSP (ug/m3)
BURN 334A										
DD-334A	Upwind	492.5	<	138.0	1.75	0.006	<	0.00958	0.72	18.7
EE-334A	Downwind	121.6	<	137.7	1.17	0.005	<	0.01025	0.29	22.9
II-334A	Downwind	333.8	<	138.2	1.22	0.004	<	0.00943	0.68	24.6
HH-334A	Downwind	407.5	<	137.8	1.36	0.006	<	0.00973	0.70	26.5

NOTES:
< = Not detected.

	NH3-N	HCl in air	Al	Cr	Pb	CO	TSP
COUNT:	3	3	3	3	3	3	3
MEAN DOWNWIND CONC.:	288	68.9	1.25	0.01	0.0049	0.557	24.7
STANDARD DEVIATION:	121	0.12	0.08	0.001	0.0003	0.189	1.5
SQRT(N+1/n):	1.15	1.15	1.15	1.15	1.15	1.15	1.15
SAMPLE t VALUE:	1.46	0.42	5.41	0.80	0.2	0.75	3.49
DEGREE OF FREEDOM:	2	2	2	2	2	2	2
CRITICAL t VALUE:	6.965	6.965	6.965	6.965	6.965	6.965	6.965
COMMENTS:	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN	*NOT SIGN	NOT SIGN	NOT SIGN

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